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ILLINOIAN AND WISCONSIN DRIFT OF THE SOUTHERN PART OF THE GRAND RIVER LOBE IN EASTERN OHIO

By George W. White

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ABSTRACT

Glacial drifts of Wisconsin and Illinoian age occur in the southern part of the Grand River lobe in eastern Ohio.

The Illinoian, which occupies a belt only 2 to 5 miles wide, extends eastward from Canton across Stark and Columbiana counties. This is mainly till, now discontinuous and thin. Oxidation reaches a depth of 12 feet or more, and leaching 11 feet or more. Small areas of Illinoian kames and kame terraces remain.

In the Wisconsin till, which covers the area north of the Illinoian, oxidation reaches depths of 8 to 11 feet, and leaching 5 to 7 feet. A partially discontinuous end moraine lies 1 to 2 miles inside the southern limit of this drift, and a very strong end moraine lies along the west side of the lobe.

Within the Wisconsin area relatively minor kame terraces occupy some of the valleys. The Wisconsin ice disappeared mainly by northward retreat of an ice edge, but stagnated to a limited extent in small areas.

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INTRODUCTION

This paper reports (1) the position of the outer margin of the drift across the Grand River lobe in eastern Ohio, (2) the margin of the Wisconsin "terminal moraine" supposed to lie a very few miles north of the outer drift margin, (3) the age of the "extramorainal" drift or "fringe", and (4) the mode of retreat of the Wisconsin ice of the Grand River lobe.

LOCATION

The area studied, in central-eastern Ohio (Fig. 1), is covered by topographic maps of the Canton, Alliance, Lisbon, Columbiana, Dover, Carrollton, Salineville, and Wellsville quadrangles. All of the first four and the northern halves of the last four were used in the construction of the base map for Plate 1.

The area is within the Allegheny plateau

FIGURE 1.—INDEX MAP OF OHIO

Showing Wisconsin glacial lobes, Wisconsin drift border (solid line), Illinoian drift border (broken line) and area shown in Plate 1.

province. The Ohio River crosses the extreme southeastern corner, but most of the area is drained by streams tributary to the Tuscarawas River, by the Mahoning River, or by the tributaries of Little Beaver Creek (Pl. 1). The tops of hills range between 1200 and 1300 feet in elevation. The relief is of the order of 200 feet, but is as much as 300 feet in a few places and less than 100 feet north of Alliance.

ACKNOWLEDGMENT

The field work was principally financed by a grant from the Penrose Bequest of The Geological Society of America, for which appreciation is here expressed.

EARLIER WORK

Early observations on drift in Ohio were made by Volney (1804, p. 83, Fig. 3), Drake (1815, p. 74), and Mather and others (1838). General observations in northeastern Ohio were made by Whittlesey (1866), Newberry (1874; 1878a; 1878b; 1878c), Chamberlin (1883, p. 313), Lewis (1884, p. 200), and Wright (1884a; 1884b; 1884c; 1890). Wright emphasized the "fringe" of attenuated drift in Columbiana

and Stark counties. Leverett (1902, p. 351) interpreted the "extramorainic drift", the "fringe" of Wright, as early Wisconsin and again referred this drift in western Pennsylvania (1934, p. 108) "to the Wisconsin stage." White (1942; Flint and others, 1945) interpreted the outer marginal drift as Illinoian; the present paper sets forth the supporting data. Stout and others (1943, p. 23) referred the "fringe" to a Kansan or pre-Kansan age. MacClintock and Apfel (1944) interpreted the border drift adjacent to the Ohio line in eastern Pennsylvania as Illinoian.

Illinoian Drift

Introduction

Drift interpreted as Illinoian extends from east to west across the area in a belt 2 to 5 miles wide. It lies south of the Wisconsin drift and consists of more or less discontinuous deposits of deeply weathered till, except for three small tracts of kames. It is the marginal drift of an Illinoian Grand River lobe, which came from the same direction and under the same topographic controls as the later Wisconsin ice.

Illinoian Boundary

The boundary of the Illinoian drift extends generally west from the Pennsylvania-Ohio State line across Columbiana and eastern Stark counties to a point 3 miles south of Canton, where the Illinoian is overlapped by the Wisconsin drift of the Killbuck lobe (Pl. 1). This is approximately the southern margin of the "fringe" of Lewis (1884, p. 200) and of Wright (1884a, Pls. 8, 9) from the State line to Robertsville in eastern Stark County, but differs from it west of that village. Across Columbiana County the drift margin as drawn on Plate 1 agrees with that of Stout and Lamborn (1924, map 3).

The boundary is marked by a moraine only near Bayard in western Columbiana County and must be drawn through the locations of the southernmost erratics. At places these are widely spaced and so sparse that the boundary has been shown by a dashed line.

Illinoian Till

The Illinoian till is, in general, so thin that most of even the thicker outcrops consist of only a few feet of strongly altered material between the soil and the bedrock. The rare outcrops of unaltered till exhibit the characteristic five zones or horizons of weathering (Leighton and MacClintock, 1930, p. 31, Fig. 1) similar to those of the eastern side of the Scioto lobe in eastern central Ohio (White, 1939).

Only rarely is the Illinoian drift of the Grand River lobe thick enough to preserve unaltered till. Unaltered till of Horizon 5 is exposed in a strip mine at the southeast corner of the corporation limit of Rogers, in Middleton Township, Columbiana County, as a bluish-gray, moderately calcareous, tough, silty, pebbly to cobbly boulder clay (Fig. 2, A). The top of Horizon 5 is 12 feet below the surface.

Horizon 4 is calcareous till similar to Horizon 5, except for oxidation to a brown color. At Rogers, Horizon 4 is only 8 inches thick (Fig. 2, A), and the depth of oxidation compares well with that in the Illinoian till of the eastern part of the Scioto lobe (White, 1939, p. 165, Fig. 3).

Horizon 3 is quite similar to Horizon 4, except that the carbonates have been leached. The depth of leaching at Rogers is 11 feet, 4 inches. In SW Section 22, Center Township, Columbiana County, the depth of leaching is more than 11 feet, but the base of Horizon 3 is not exposed (Fig. 2, B).

Horizon 2 is the zone of decomposed till underlying the true soil. It is not only oxidized and leached but also thoroughly weathered, and contains fewer pebbles and cobbles than the lower horizons. The upper part of the horizon is mottled buff to gray to brown. The lower part is more uniformly brown and has dark stains along the joints. Horizon 2 has not been weathered to gumbotil, because of the excellent drainage of the region, although in a similar region in New York Illinoian gumbotil has been reported (MacClintock and Apfel, 1944, p. 1147).

Horizon 1 is the soil, divided into A and B horizons of pedologists.

Ground Moraine

The region, underlain by almost horizontal Pennsylvanian strata, was maturely dissected in pre-Illinoian time. It was thinly covered by Illinoian till which at most places only slightly

modified the pre-existing topography. Since Illinoian time the till has been deeply weathered and largely removed. Constructional topography is rarely preserved. The difference in aspect between the area glaciated by Illinoian ice and the unglaciated region to the south is very slight. Far greater difference is exhibited between Illinoian and Wisconsin topography than between Illinoian and unglaciated areas.

Although most small areas of now somewhat subdued constructional topography are related to tracts of kames, a few such areas in which the material is till are in Columbiana County in S Section 9, Middleton Township between Rogers and Negley; small tracts in Center Township, west of Lisbon; near the glacial boundary 1½ miles east of Dungannon; in Stark County, along the walls of the valley of Little Sandy Creek in Osnaburg Township from 2 miles north of Mapleton northeastward to the township line; in Section 15 and 11 of the same township, northwest of Mapleton; and just southwest of East Canton.

An interesting "island" of Illinoian drift is preserved in the re-entrant angle between the Killbuck and Grand River lobes of Wisconsin drift in the northwestern part of Canton and for a mile north of the city, west of West Branch. Fulton Street crosses the center of the area. The Illinoian drift of the tract varies from thoroughly weathered till rarely more than 2 or 3 feet thick to only scattered pebbles overlying the bedrock which outcrops in many localities along the streets and below the Canton stadium.

Kames

Three areas of kames exist within the Illinoian area. Just southeast of Negley, 1½ miles west of the State line, gentle kames 10 to 30 feet high lie upon a Teays (Parker Strath) rock terrace (Stout and Lamborn, 1924, p. 41). The material is poorly sorted gravel in which considerable till is intermixed.

From the south margin of Rogers, 5 miles east of Negley, gravelly drift extends southward for about a mile in a valley tributary to Bull Creek. In a coal strip pit a quarter of a mile south of the village thoroughly leached, medium to cobbly gravel 4 to more than 10 feet thick overlies the bedrock. The surface is undulating rather than hummocky and has been much modified by erosion.

The largest area of kames lies along the Illinoian boundary on the south valley wall of Sandy Creek, south of Bayard, just east of the Stark County line, where three irregular tracts each having an area of about a quarter of a square mile occupy re-entrants of the valley wall. Gravel pits expose as much as 40 feet of medium gravel, containing a few cobbles and rare boulders, in beds which dip steeply in various directions. The prevalence of till masses included in the gravel is reported to have caused abandonment of some pits formerly operated. Much of the gravel is leached 8 to 10 feet and oxidized 12 feet or more, but greater depths are not uncommon.

The surface is definitely hummocky; the knolls out from the valley wall rise 40 to 50 feet. Those on the valley wall appear as swells upon the larger bedrock hills. The knolls are smooth and rounded and do not have the sharp, irregular aspect characteristic of Wisconsin kames.

The widely scattered kame areas in the Illinoian drift area of the Grand River lobe are comparable to those of the Illinoian drift area of the east side of the Scioto lobe (White, 1939, p. 169–173).

Valley Trains

The only valley-train deposit referable to Illinoian meltwater is a remnant in the valley of Sandy Creek just east of Magnolia, shown on Plate 1 east of the village and south of the creek as an area without pattern surrounded by later Wisconsin valley train. It has been described by Leverett (1902, p. 285) and by Ireland (1940, p. 1350). An Illinoian valley train was probably once continuous from the drift boundary in Sandy Creek to the Tuscarawas River and thence down that valley. Ireland discovered (p. 1345) an Illinoian valley-train remnant in the Tuscarawas valley about 30 miles south-southwest of Magnolia. Still farther south, along the Muskingum valley, are high terrace remnants which are probably Illinoian, although no detailed studies of them have been reported.

Age Assignment as Illinoian

Proof that the area here mapped as Illinoian is indeed pre-Wisconsin is:

(1) Fresh Wisconsin valley trains rise at or within the Wisconsin drift and pass through the wide valleys of the Illinoian region to the unglaciated area. These trains received no contributions from the Illinoian area. The major erosion of the Illinoian area was accomplished before the fresh valley trains were deposited in the already wide valleys.

(2) The Illinoian till is distinctively more weathered than the Wisconsin till.

(3) The erosion of the Illinoian area has progressed much and distinctively farther than in the Wisconsin area. The erosion has gone so far as to remove much of the Illinoian till which is much more discontinuous and patchy than is the Wisconsin.

This pre-Wisconsin drift is interpreted as Illinoian because the topography and depth of weathering of the till are similar to those of a belt of pre-Wisconsin drift on the east side of the Scioto lobe (White, 1939) whose Illinoian age has been long accepted on the basis of continuous tracing into the wider Illinoian area of western Ohio, Indiana, and Illinois. In both areas erosion has removed much till, drainage is integrated, and the general aspect more nearly resembles that of the unglaciated area to the south and east than it does that of the more recently glaciated Wisconsin drift area. In both Illinoian drift regions the depth of oxidation (base of Horizon 4) is between 12 and 17 feet, the depth of leaching (base of Horizon 3) is between 8 and 12 feet, and the thickness of Horizons 2 and 1 (thoroughly decomposed till and soil) is between 4½ and 6 feet.

Wisconsin Drift of Grand River Lobe

Boundary

The boundary of the Wisconsin drift enters Ohio from Pennsylvania 1 mile south of East Palestine and passes in a general westerly direction to Canton (Pl. 1). At Canton the margin of the Wisconsin Killbuck lobe forms a re-entrant angle with that of the Grand River lobe; the boundary of the Wisconsin drift thence passes southward and southwestward to the Tuscarawas River. The marginal Wisconsin drift of the Grand River lobe seldom exhibits good morainal topography at the actual boundary, although morainal expression 1 to 2 miles north of the boundary is usual.

Till

The Wisconsin till of the Grand River lobe, of which several sections are shown in Figure 1, may be divided into five horizons as is the Illinoian drift. The depth of development is less, and Horizon 2 is much thinner. Horizons 5 and 4 are similar to those of the Illinoian drift.

The unaltered till of Horizon 5 is a blue-gray, strongly calcareous, tough, silty to sandy, pebbly to cobbly boulder clay, in which boulders and blocks up to 6 feet in size may be present.

Horizon 4 is calcareous till oxidized to a brown color, but otherwise similar to that of Horizon 5. The base ranges from 8 to 11 feet below the surface but generally is about 9 feet.

The till of Horizon 3 is noncalcareous, but otherwise closely resembles the till of Horizon 4. The base of the horizon is from 5 to 7 feet, but is generally 6 feet or less below the surface.

The thoroughly weathered till of Horizon 2 is thinner than that horizon of the Illinoian drift. Its base is from 3 to 4½ feet, but usually is about 3½ feet below the surface.

Horizon 1, the A and B soil zones, ranges in thickness from 1½ to 2½ feet and generally is less than 2 feet. The soils are sandy loams, loams, and silt loams of several series, depending on the character of parent material and conditions of drainage under which they developed. The morainic tracts are more characteristically loam, sandy loam, and even gravelly loam in certain kame areas. The soils of the ground moraine are usually silt loam.

Between and north of Alliance and Sebring is the southern tip of an area, extending northward to Lake Erie of very clayey till containing few pebbles and cobbles. The clay till is oxidized 10 feet or more but is leached only 3 to 4 feet, apparently because of tightness and poor internal and surface drainage. The soils developed in this clayey till are fine silt loams,

silty clay loams, and clay loams (Mooney and others, 1915, map; Beck and Gossard, 1919, map).

tent probably contributes to variation in depth of leaching, but its importance cannot be assessed from data from this area.

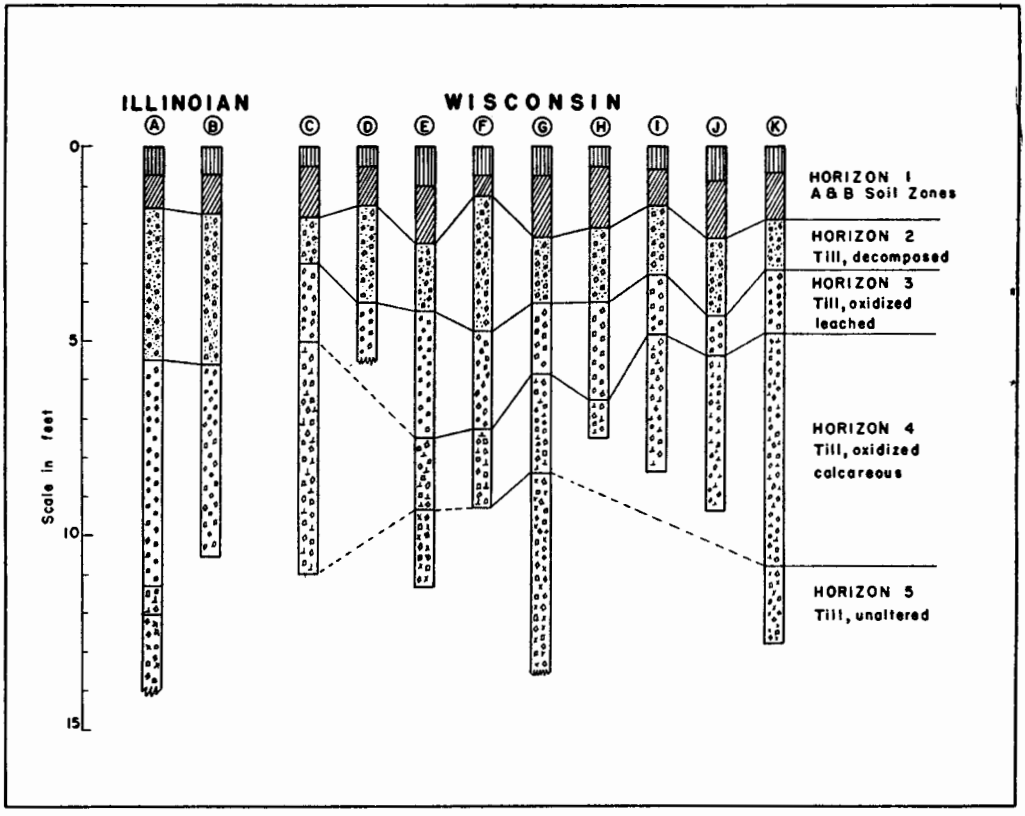

FIGURE 2.—COLUMNAR SECTIONS OF ILLINOIAN (A and B) AND WISCONSIN (C to K) TILL

Illinoian Till

A. Strip mine, northeast part of Rogers, Middleton Twp., Columbiana Co.
B. Road cut, SW¼ Sec. 22, Center Twp., Columbiana Co.

Wisconsin Till

C. Strip mine, SW¼SW¼ Sec. 35, Unity Twp., Columbiana Co.
D. Road cut, NE¼NW¼ Sec. 33, Unity Twp., Columbiana Co.
E. Road cut, ½ mi. west of East Fairfield, Fairfield Twp., Columbiana Co.
F. Road cut, SE¼SE¼ Sec. 16, Center Twp., Columbiana Co.
G. Strip mine, ¾ mi. SSE of Teegardin, Salem Twp., Columbiana Co.
H. Road cut, SW¼NW¼ Sec. 23, Butler Twp., Columbiana Co.
I. Road cut, ½ mi. east of New Alexander, West Twp., Columbiana Co.
J. Road cut, 1 mi. west of New Garden, Hanover Twp., Columbiana Co.
K. Road cut. NE¼SE¼ Sec. 23, Washington Twp., Stark Co.

The considerable variation in depth of leaching in Wisconsin till of the same or only slighly different age is due to a number of factors. Variation in surface drainage has some effect, but permeability of the till is more important. Coarser and more pebbly till is more deeply leached than the finer, more compact till near Alliance. Variation in original carbonate con-

The margin of the clay till, which is not marked by a moraine, is the limit of a later readvance of the Wisconsin ice which had retreated several tens of miles northward, possibly even into the Erie basin, before readvancing with a burden of debris derived from the fine-grained Devonian shales and from lacustrine deposits of a very early stage of glacial

Lake Erie. This readvance represents a substage of the Wisconsin of northeastern Ohio and is the subject of investigations now in progress (White, 1950).

Ground Moraine

More than half the surface of the Wisconsin drift is classified as ground moraine. It has characteristically a rolling to gently undulating surface. Swells having a relief of more than 10 feet in a quarter of a mile are uncommon except as moraine areas are approached. Irregular tracts of less than 1 to 2 or 3 square miles in Mahoning and northeastern Columbiana counties have a somewhat more undulatory surface than most of the gound moraine and are intermediate in surface character between the ground moraine and the more prominently constructional aspect of the morainic areas. It is not attempted here to map them separately, and they are included with the ground moraine. In the more hilly southern part of the Wisconsin area the drift is plastered on the bedrock hills, producing characteristic undulation of the slopes which thereby differ from the smoother and more regular erosional slopes of the Illinoian and of the unglaciated area to the south.

The ground-moraine surface in the clay till area north of Sebring and Alliance in some places has a relief of less than 20 feet in a mile.

The ground moraine has a variable thickness. At very few places bedrock crops out. Road cuts, strip mines, and well records show that in the ground-moraine areas the drift is usually not over 40 feet thick and very often is between 10 and 30 feet.

Morainic Areas

Included under the term "morainic areas" (Pl. 1) are irregular drift deposits which are probably not genetically homogeneous. The large linear area on the west side of the lobe north of Canton is a massive terminal end moraine. The areas near the south margin are likewise of end-moraine origin. However, parts of these latter areas and other separate areas, especially southeast of Salem, appear not to be true end moraines but masses of hummocky-surfaced thicker drift related to the irregular bedrock surface, especially of valleys and valley walls (White, 1949, p. 34). The designation "morainic areas" is used as a more general term than "end moraine" or "terminal moraine" because the areas are not exclusively such.

One of the two largest areas of well-developed hummocky topography is that along the southern part of the lobe in western Columbiana and eastern Stark counties. Some knolls are as much as 30 feet high and have an area of 20 to 40 acres, but most are not so strong.

In the area from Canton north to Hartville, and extending with even stronger development north of the area of Plate 1 across Portage County to Geauga County, the morainic topography is the most rugged of the Grand River lobe and, indeed, in the whole state. Sharp knolls, many of them kames, are as much as 60 feet high, and farther north in Portage County some knolls are 200 feet high. Near Hartville kettle holes have flat peat and muck-covered floors more than a square mile in area which support an extensive vegetable-raising industry.

The drift of the morainic areas ranges from 20 to 30 feet to well over 100 feet in thickness (Schaefer, White, Van Tuyl, 1946, Pl. 2). Near Hartville a buried valley is filled with 400 feet of drift, but probably not all of this is Grand River Wisconsin drift.

The till of the morainic areas is somewhat coarser than that of the ground moraine. Some of the till, especially that north of Canton, is gravelly, and gravel masses occur in it. The soils are of the Wooster series, mainly Wooster loam and Wooster gravelly loam, but in some of the less well developed areas of moraine, composed of less coarse till, the soils are Volusia (Ravenna) and Canfield loam (Mooney and others, 1915, map).

Kame Terraces

East Palestine area.—Near the headwaters of Leslie Run, a kame terrace an eighth of a mile wide heads in a tributary to Bull Creek, midway between East Palestine and New Waterford in northeastern Columbiana County, and continues downstream on the west and douth side of the valley for 3 miles to East Palestine. The terrace declines from an elevation of 1080 feet at its head to about 1040 feet in East

Palestine. The surface is hummocky with knolls rising as high as 20 feet above the general level and a few shallow kettle holes. The material is gravel with some till included, but details are unknown because of the absence of gravel pits or other good outcrops.

Washingtonville—Franklin Square area.—A complex series of ice-marginal deposits occupies a part of the present valley of Middle Fork of Little Beaver Creek and a part of its earlier valley. The terraces vary in height and were formed at different times. The terrace south of Franklin Square was formed at one time, the middle segment at Washingtonville and Leetonia appears to have been deposited later, followed by still later more northerly deposits. Buried ice blocks must have remained in the axial part of the valley at least as far south as Franklin Square until deposition of outwash ended in the valley; otherwise, a central valley train would be more prominent. It is believed that after the deposition of the terraces the ice masses against which they were deposited shrank, but did not disappear. When outwash no longer came from the north the thinner buried blocks finally melted, and the present valley flat was formed by post-glacial stream action.

From the county line, 1 mile northeast of Salem, a very irregular terrace, made up of massed kames 10 to 40 feet high, lies on the southwest side of the valley. The material is a mixture of gravel, sand, silt in dipping beds, and till masses, bearing evidence of deposition in pools marginal to ice, into which some till slumped and was covered before it could be completely sorted. The contorted bedding indicates collapse as a result of melting of buried and adjacent ice.

Just north of the county line, about 2 miles west-northwest of Washingtonville, a prominent terrace rises sharply 75 feet above the valley bottom. The surface of the terrace ranges in elevation from 1100 to 1120 feet. It is undulatory but has no sharp knolls. A few shallow kettle holes have areas of from 1 to 3 acres. The material is very coarse cobbly gravel, but the character of the bedding is not clearly exposed.

Beginning at the east end of the high terrace a lower terrace follows the north valley side to Washingtonville. Here Middle Fork leaves its wide valley and turns south for 2½ miles in a narrow valley across the upland, rejoining the old valley at Franklin Square. The later narrow valley has no terrace deposits except for low terraces an eighth of a mile wide on either side of the northern half-mile end. The gravel deposits in the abandoned valley continue east through Washingtonville, turn south in the southeast part of the village, and continue to Leetonia. A belt of kames extends southwest from the west margin of Columbiana to join the main line of deposits in southeast Leetonia. The material just east of Leetonia is mainly sand and fine gravel with approximately horizontal bedding making up a level wash plain with an area of 1 square mile.

From Leetonia to Franklin Square only a very narrow and discontinuous kame terrace of coarse cobbly gravel was deposited along the southeast valley wall. From Franklin Square, where Middle Fork re-enters the ancient valley, a strong terrace having a maximum width of half a mile was deposited along the southeast side of the valley for 3 miles southwest. The terrace rises 100 feet above the inner floor of the valley. Its surface declines from 1100 feet near Franklin Square to 1080 feet 3 miles downstream. The surface is markedly hummocky, separate kames are 20 to 40 feet high, and several kettle holes are 10 to 20 feet deep. Two bedrock hills veneered with till rise 60 feet or more above the terrace in the southern part and are large enough to be shown on the map (Pl. 1). At the south end of the terrace the valley of Middle Fork becomes narrow and gorgelike almost to Lisbon; it contains no outwash.

North Georgetown area.—In the vicinity of North Georgetown, in the northwestern part of Columbiana County, very hummocky and irregular kame terraces lie on both sides of the Mahoning River valley and of a tributary entering near Georgetown from the south-southwest. The material is gravel and coarse sand, in which till masses are included. Kames are as high as 40 feet, and some kettle holes are 20 feet deep. The general surface of the terraces in the Mahoning valley declines northwestward from 1220 feet at the southeast to 1160 at North Georgetown. The terraces in the tributary valley are continuous with these in the main valley and decline from 1160 at North Georgetown south-southwest to about 1120

feet at their southern ends, in a direction opposite to the flow of the present stream. The glacial meltwater flowed south to Sandy Creek in a now-abandoned spectacular narrow gorge at the head of the present valley.

Valley Trains

General statement.—Only minor valley-train deposits occur in the valleys of the Little Beaver Creek drainage, but they are much more extensive in the valleys of the Sandy Creek and Nimishillen Creek systems (Pl. 1). The outwash terraces along the Ohio River were not studied.

Little Beaver Creek basin.—In the valleys of Bull Creek and of North Fork near Negley, at the eastern margin of Ohio, are terrace remnants of Wisconsin valley train composed of sand and sandy gravel. The terraces rise from 10 to 20 feet above the present flood plain.

Small terrace remnants of sand and fine gravel lie on either side of the valley of Little Bull Creek at Rogers and upstream from the village. The valley train here is not continuous with that farther downstream at Negley because the valley is very narrow and rock-walled, and no outwash deposits were made in this narrow segment.

A valley train, of which terrace remnants now rise 20 to 40 feet above the present stream, was deposited in the valley of Middle Fork from 2 miles northwest of Lisbon downstream to Elkton. The most extensive remnants are at Lisbon. The material is sand, sandy gravel, and gravel, with occasional larger cobbles.

Elsewhere in the valleys of Little Beaver Creek and its tributaries beyond the Wisconsin border outwash is absent or only scantily represented by a few cobbles and pebbles.

Sandy Creek basin.—The extensive valley trains of Sandy Creek and its tributaries are in distinct contrast to the meager ones of the Little Beaver basin and, indeed, have influenced the very name of the stream. The trains rise at or within the Wisconsin border and pass through the narrow belt of Illinoian drift to the unglaciated area (Pl. 1). The separate trains in the valleys of Upper Sandy Creek, Hugle Run, Little Sandy Creek, and Nimishillen Creek all contribute to the strong valley train of the main Sandy Creek Valley.

The deposits are well-washed and well-bedded coarse sand and gravel. Cobbles up to 4 inches are not uncommon. The soils of the trains are distinctive Chenango gravelly loam. The extent of the deposits and the subsequent erosion of them by present streams within Stark County are well shown on the soil map of the county (Mooney and others, 1915).

Nimishillen valley.—Almost all the area upon which Canton is built is an outwash plain to which deposits were contributed by meltwater which flowed down East, Middle, and West forks to unite in the Canton area. A direct contribution was made from Killbuck ice in the east part of Canton. The outwash passes down Nimishillen Creek and joins the valley train in Sandy Creek valley.

The material varies from boulder gravel at the ice edge in northern Canton to cobbly, medium, and fine gravel away from the ice margin. The outwash from the Killbuck lobe is cobbly near the margin but not bouldery. On the whole the deposits in the Nimishillen system are somewhat finer than in the Sandy system, and the soil is Chenango silt loam (or sandy loam?) rather than gravel loam (Mooney and others, 1915).

Drift of Killbuck Lobe

The Wisconsin drift lobe between the Grand River lobe on the east and the Scioto lobe on the west was originally called the "Shoulder of the Scioto lobe" (Leverett, 1902, p. 403) but is now known as the Killbuck lobe (White, 1934a). The border of the Wisconsin drift of the Killbuck lobe trends south from the junction with the Grand River lobe in the valley of West Branch 1 mile north of the Canton city limit.

The moraine area of the Killbuck lobe is one of striking topographic appearance. As it joins the most western part of Grand River moraine, also of strong development, and as the drifts are similar in appearance, in weathering, in surface expression, and in lithology, it is impossible at present to draw a boundary between the two lobes through the combined moraine tract, and no definite boundary is shown on Plate 1. The more gravelly morainic areas provide large supplies of ground water (Schaefer, White, Van Tuyl, 1946; Kazmann, 1949).

The Killbuck Wisconsin drift is approximately of the same age as the Grand River Wisconsin drift, but evidence now appearing to the north points toward a very slightly later time of maximum advance of the Killbuck lobe.

Age of Wisconsin Drift

The Wisconsin drift must be correlative with either Tazewell or Cary of the Mississippi valley succession, but the age cannot be established solely from this area. Work now in progress to the north and northwest, where correlation can be made with definite end moraines entering the plateau from the till plains, indicates that the margin of the clay till of northeastern Ohio, which enters the area of Plate 1 for only a short distance near Alliance, is pre-Defiance but apparently only slightly so and is therefore middle to late Cary. There is indication 20 miles north of the northwest part of this area that the time between retreat of the Grand River ice and the readvance to deposit the clay till was not long. As the clay till is middle to late Cary, the coarser, earlier Wisconsin drift of this region is probably early Cary. It is believed not to be Tazewell, as Wisconsin drift near Akron is definitely older than the Grand River drift of the area here discussed and is probably Tazewell (White, 1950).

Summary of Glacial History

Pre-Illinoian

No evidence of pre-Illinoian glaciation exists within the area described. Indirect evidence of pre-Illinoian glaciation elsewhere in northern Ohio is afforded by the sequence and pattern of drainage changes (White, 1934b), but these have not been traced into the present area.

Illinoian

The demonstrably older drift south of the fresher Wisconsin drift was deposited by a Grand River lobe of Illinoian ice which invaded northeastern Ohio and northwestern Pennsylvania. In its advance the ice deposited over the bedrock irregularities a till sheet which near its margin was certainly thin, and may have been discontinuous. No strong terminal end moraine was formed, but in a few widely separated favorable places marginal kames were left. Retreat of the marginal ice was at least in part by stagnation, as minor kame terraces are preserved near Negley and Rogers.

Meltwater flowed to the Ohio River, and valley trains, of which only widely separated small remnants now remain, were deposited beyond the glaciated area.

Wisconsin

The Wisconsin ice advanced from a generally northerly direction in a Grand River lobe to the margin shown on Plate 1. A terminal moraine was not made precisely at the farthest limit of ice advance, but an end moraine several miles wide, not entirely continuous from east to west, was formed near the limit of advance. An east-west moraine over 6 miles long north of Salem indicates at least local readvance and oscillation along a line 10–12 miles north of the line of greatest advance.

After the farthest advance, the retreat of the ice to the northern limit of the area was in part irregular in that the ice melted down as well as back. Ice tongues and masses were left in some of the valleys. These may in part have been projections of the main ice sheet, but some of them were entirely separated. Over, around, and at the sides of these elongate masses kame terraces were deposited. The absence of kame terraces in some valleys where they might be expected shows that not all valleys retained dead ice masses. The ice dissipation appears to have been not entirely, or even in large part, by stagnation but by northward retreat of generally active ice, but which had in some places areas of weakly active or completely dead ice.

From the time of maximum ice advance and thereafter meltwater escaped southward, laying down valley trains which extend far beyond the area.

In the Killbuck lobe the ice advanced from a generally northwesterly direction to a north-south line through the west part of Canton. The advance of the Killbuck lobe was at about the same time as the Grand River lobe but may have been slightly later. The margin in contact with the Grand River lobe is not definite.

From the Killbuck lobe was deposited a strong marginal moraine, in part a kame moraine. So little of the Killbuck lobe is included in the area that discussion of the mode of ice retreat of that lobe is not appropriate here.

Meltwater from the Killbuck lobe flowed down West Branch and east from the ice margin in western Canton to that stream and thence down Nimishillen Creek to Sandy Creek. Meltwater from the more southerly Killbuck lobe flowed directly to the Tuscarawas River.

References Cited

Beck, M. W., and Gossard, O. P. (1919) *Soil survey of Mahoning County, Ohio*, U. S. Dept. Agric., Bur. of Soils Field Operations, 1917, 41 pages.

Chamberlin, T. C. (1883) *Preliminary paper on the terminal moraine of the second glacial epoch*, U. S. Geol. Survey, 3d Ann. Rept., p. 291–402.

Drake, Daniel (1815) *Natural and statistical view, or picture of Cincinnati and the Miami country*, Cincinnati, 251 pages.

Flint, R. F., and others (1945) *Glacial map of North America*, Geol. Soc. Am., Spec. Papers, no. 60.

Ireland, H. A. (1940) *New evidence for an Illinoian glacial boundary in northeastern Ohio*, Geol. Soc. Am., Bull., vol. 51, p. 1337–1358.

Kazmann, R. G. (1949) *The utilization of induced stream infiltration and natural aquifer storage at Canton, Ohio*, Econ. Geol., vol. 44, p. 514–524.

Leighton, M. M., and MacClintock, Paul (1930) *Weathered zones of the drift sheets of Illinois*, Jour. Geol., vol. 38, p. 28–53.

Leverett, Frank (1902) *Glacial formations and drainage features of the Erie and Ohio basins*, U. S. Geol. Survey, Mon. 41, 802 pages.

—— (1934) *Glacial deposits outside the Wisconsin terminal moraine in Pennsylvania*, Penna. Geol. Survey, 4th ser., Bull. G7, 123 pages.

Lewis, H. C. (1884) *Report on the terminal moraine in Pennsylvania and western New York*, Second Geol. Survey Penna., Rept. Prog., Bull. Z. 299 pages.

MacClintock, Paul, and Apfel, E. T. (1944) *Correlation of the drifts of the Salamanca reentrant, New York*, Geol. Soc. Am., Bull., vol 55, p. 1143–1164.

Mather, W. W., and others (1838) *Second Annual Report of the Geological Survey of the State of Ohio*, Columbus, Ohio, 286 pages.

Mooney, C. N., Tuttle, H. F., and Bonazzi, A. (1915) *Soil survey of Stark County, Ohio*, U. S. Dept. Agric., Bur. of Soils, Field Operations 1913, 39 pages.

Newberry, J. S. (1874) *Surface Geology [of Ohio]*, Geol. Survey Ohio, vol. 2, pt. 1, p. 1–80.

—— (1878a) *Report on the geology of Columbiana County*, Geol. Survey Ohio, vol. 3, p. 90–132.

—— (1878b) *Report on the geology of Stark County*, Geol. Survey Ohio, vol. 3, p. 151–176.

—— (1878c) *Report on the geology of Mahoning County*, Geol. Survey Ohio, vol. 3, p. 781–814.

Schaefer, E. J., White, G. W., and Van Tuyl, D. W. (1946) *The ground water resources of the glacial deposits in the vicinity of Canton, Ohio*, Ohio Water Resources Bd, Bull. 3, 60 pages.

Stout, Wilber, and Lamborn, R. E. (1924) *Geology of Columbiana County*, Geol. Survey Ohio, Bull. 28, 408 pages.

——, Ver Steeg, Karl, and Lamb, G. F. (1943) *Geology of water in Ohio*, Geol. Survey Ohio, Bull. 24, 694 pages.

Volney, C. F. (1804) *View of the climate and soil of the United States of America, translated from the French*, London, 503 pages.

White, G. W. (1934a) *The Pleistocene geology of the region of the re-entrant angle in the glacial boundary in north central Ohio*, Ohio State Univ., Abst. of Doctoral Dissert., no. 13, p. 282–293.

—— (1934b) *Drainage history of north central Ohio*, Ohio Jour. Sci. vol. 34, p. 365–382.

—— (1939) *Illinoian drift of eastern Ohio*, Am. Jour. Sci., vol. 237, p. 161–174.

—— (1942) *Illinoian and Wisconsin drift of the Grand River lobe in eastern Ohio* (Abstract), Geol. Soc. Am., Bull., vol. 52, p. 1813.

—— (1949) *Geology of Holmes County*, Geol. Survey Ohio, Bull. 47, 373 pages.

—— (1950) *Influence of Wisconsin glacial stages on soil-group boundaries in northeastern Ohio* (Abstract), Geol. Soc. Am., Bull., vol. 61, p. 1574.

Whittlesey, Charles (1866) *On the fresh-water glacial drift of the northwestern States*, Smithson. Contrib. to Knowledge, 32 pages, (in vol. 15, 1867).

Wright, G. F. (1884a) *The glacial boundary in Ohio, Indiana, and Kentucky*, Western Reserve Hist. Soc., Tract no. 60, p. 195–278.

—— (1884b) [*The glacial boundary*] *in Ohio, Kentucky, and Indiana*, in Lewis, H. C.: *Report on the terminal moraine in Pennsylvania and western New York*, Second Geol. Survey Penna., Rept. Prog., Bull. Z, p. 293–243.

—— (1884c) *The glacial boundary in Ohio*, Geol. Survey Ohio, vol. 5, p. 750–772.

—— (1890) *The glacial boundary in western Pennsylvania, Ohio, Kentucky, Indiana, and Illinois*, U. S. Geol. Survey, Bull. 58, 112 pages.

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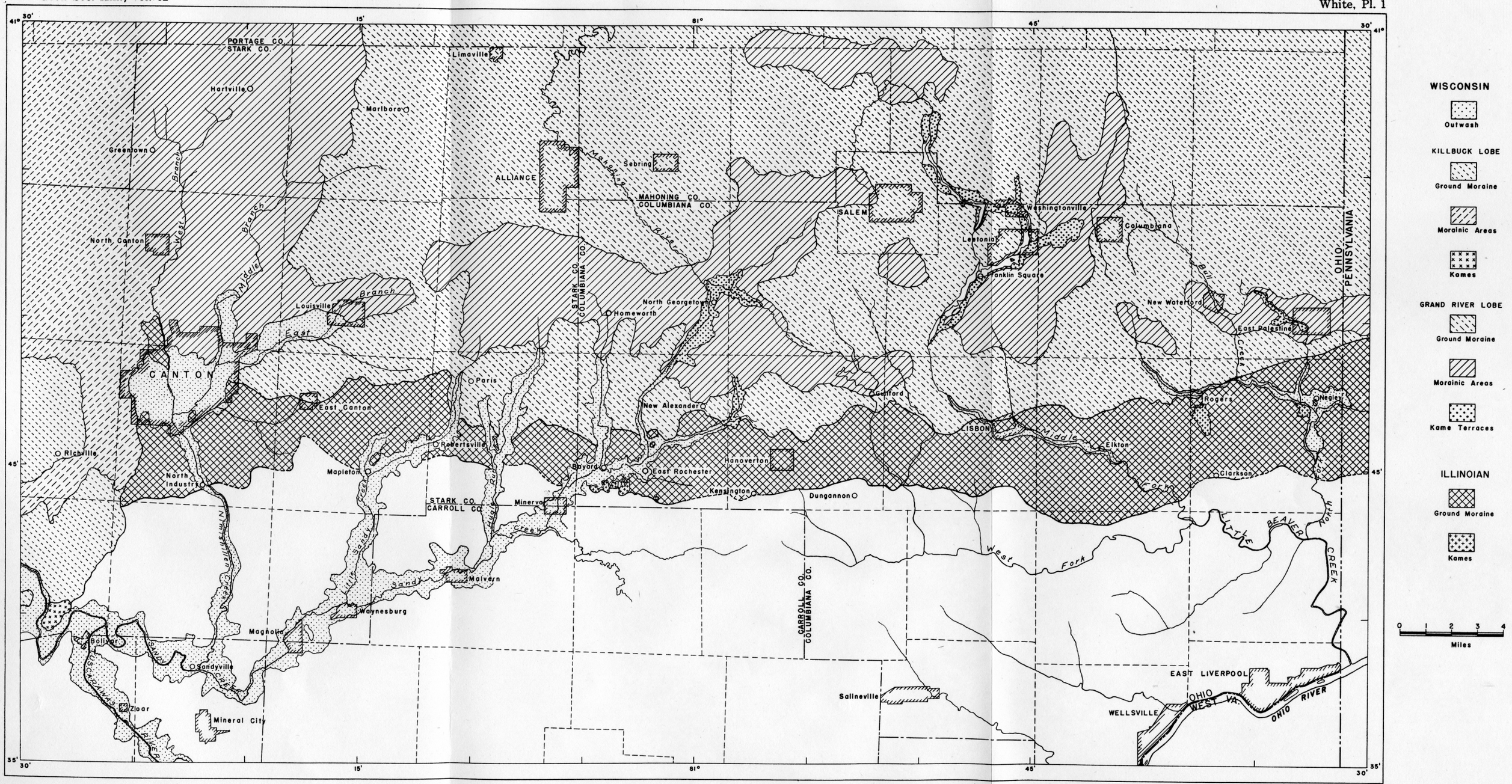

WISCONSIN

Outwash

KILLBUCK LOBE

Ground Moraine

Moraine Areas

Kames

GRAND RIVER LOBE

Ground Moraine

Moraine Areas

Kame Terraces

ILLINOIAN

Ground Moraine

Kames

0 1 2 3 4

Miles

MAP OF GLACIAL DEPOSITS IN SOUTHERN PART OF GRAND RIVER LOBE